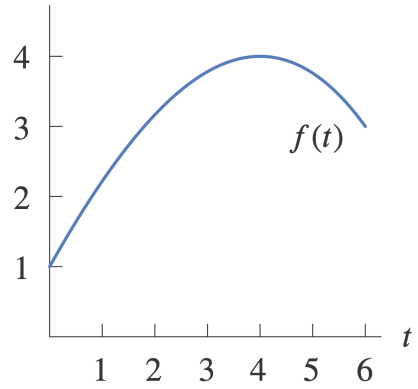
Math 115
Worksheet Section 2.1

Problem 1. (2.1 #24) The graph of $f(t)$ gives the position of a particle (in meters) at time t (in seconds). List the following quantities in order, smallest to largest.



(a) The average velocity between $t = 1$ and $t = 3$,

(b) The average velocity between $t = 5$ and $t = 6$,

(c) The instantaneous velocity at $t = 1$,

(d) The instantaneous velocity at $t = 3$,

(e) The instantaneous velocity at $t = 5$,

(f) The instantaneous velocity at $t = 6$.

Problem 2. (2.1 #27) A particle moves at varying velocity along a line and $s = f(t)$ represents the particle's distance from a point as a function of time, t. Sketch a possible graph for f if the average velocity of the particle between $t = 2$ and $t = 6$ is the same as the instantaneous velocity at $t = 5$.

Problem 3. (2.1 #34–37) Decide whether the following statements are true or false and justify.

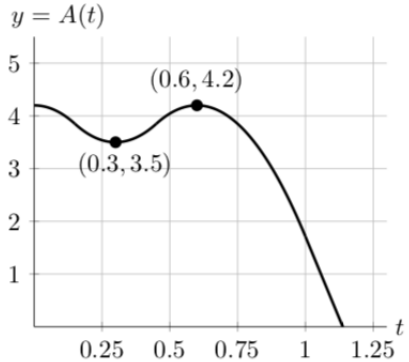
(a) If a car is going 50 miles per hour at 2 pm and 60 miles per hour at 3 pm then it travels between 50 and 60 miles during the hour between 2 pm and 3 pm.

(b) If a car travels 80 miles between 2 and 4 pm, then its velocity is close to 40 mph at 2 pm.

(c) If the time interval is short enough, then the average velocity of a car over the time interval and the instantaneous velocity at a time in the interval can be expected to be close.

(d) If an object moves with the same average velocity over every time interval, then its average velocity equals its instantaneous velocity at any time.

Problem 4. (Winter 2018 Exam 1) Tom organizes another meeting of his Science Club, but this time only Anne and John can make it. The meeting is at 2 pm, so they both start walking from their houses to Tom's at 1 pm. At 1:18 pm, Anne realizes she forgot her wallet, so she goes back home to get it before heading over to Tom's house. Anne's distance in kilometers, $A(t)$, and John's distance in kilometers, $J(t)$, to Tom's house t hours after 1 pm are given by the graph and the table below. Assume that both of them walk along a straight line.



t	0	0.2	0.4	0.5	0.8	0.9
J(t)	5.5	4.3	3.2	2.8	0.8	0

(a) How many kilometers from Tom's house is Anne's house?

(b) Estimate John's instantaneous velocity at 1:24 pm. Show all your computations. Include units.

(c) Rank John's average velocity over the time intervals

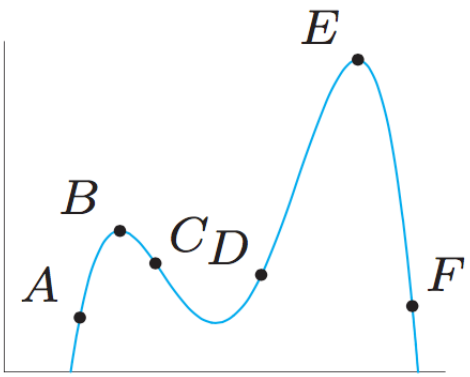
$$\text{(I) } 0.2 \leqslant t \leqslant 0.4 \qquad \text{(II) } 0.5 \leqslant t \leqslant 0.9 \qquad \text{(III) } 0.8 \leqslant t \leqslant 0.9.$$

(d) What was the total distance travelled by Anne?

(e) On which of the following intervals is $A(t)$ invertible?

$$\text{(I) } [0, 0.6] \qquad \text{(II) } [0.3, 0.6] \qquad \text{(III) } [0.1, 0.5] \qquad \text{(IV) } [0.6, 1] \qquad \text{(IV) } [0, 1].$$

Problem 5. For the function shown below, at which labeled points is the slope of the tangent line to the graph positive? Negative? At which labeled point does the graph's tangent line have the greatest (i.e., most positive) slope? The least slope (i.e., negative and with the largest magnitude)?



Problem 6. (Fall 2015 Exam 1) Angelica Neiring and Simona Koloji decide to enjoy the fall weather by racing each other from the brass block "M" in the center of the Diag along a 2.5 kilometer (2500 meter) route to the Huron River inside the Arb. Let A(t) (respectively S(t)) be Angelica's (respectively Simona's) distance along the route (in meters) t seconds after they start racing. Angelica and Simona are both wearing GPS watches that record data about their race. The table of values for the functions A and S below shows some of the resulting data

t	0	30	60	66	72	105	114	120	135	168	180	198	300
A(t)	0	55	119	137	156	226	249	265	302	384	415	463	737
S(t)	0	57	120	137	156	225	248	264	303	389	422	473	768

Use the data above to answer the questions below. Remember to show your work.

(a) Estimate Angelica's instantaneous velocity 3 minutes into the race.

(b) Estimate Simona's instantaneous velocity 2 minutes into the race.

(c) Who was ahead 5 minutes into the race?

(d) Who was running faster exactly one minute into the race?

(e) (You may use a calculator on this problem) In describing the race later, Simona says that her average velocity during the entire race was 2.8 meters per second while Angelica says that after the first 5 minutes, her average velocity for the rest of the race was 3.1 meters per second. Assuming their statements and the table of values above are accurate, who won the race? Or is there not enough information to decide? Explain your reasoning.